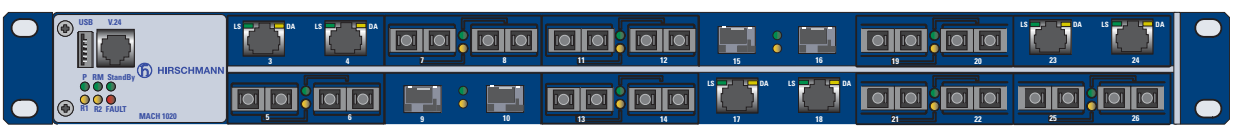
HIRSCHMANN
A BELDEN BRAND

User Manual

Installation
Industrial ETHERNET Ruggedized Switch
MACH 1000 Family



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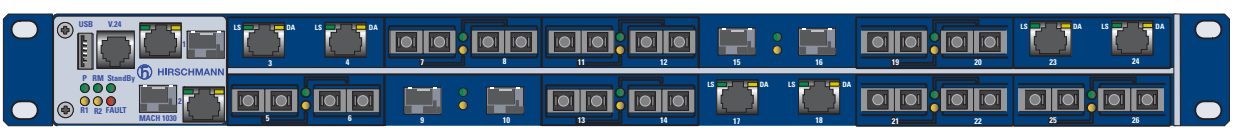

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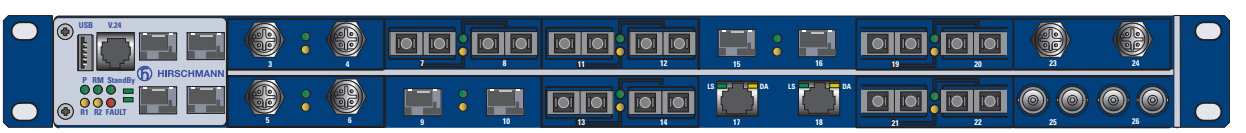

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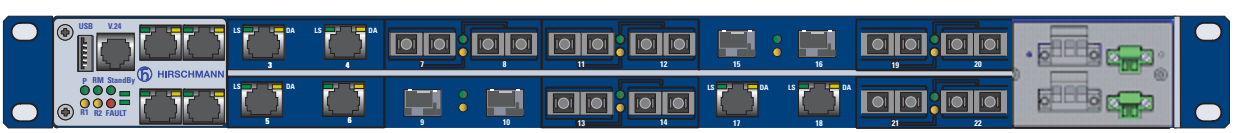

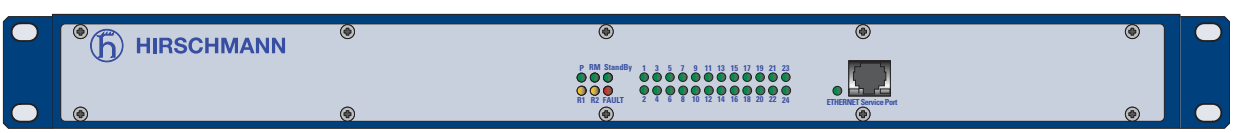

MACH 1132

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Safety instructions

This documentation contains instructions which must be observed to ensure your own personal safety and to avoid damage to devices and machinery.

Certified usage

The device may only be employed for the purposes described in the catalog and technical description, and only in conjunction with external devices and components recommended or approved by the manufacturer. The product can only be operated correctly and safely if it is transported, stored, installed and assembled properly and correctly. Furthermore, it must be operated and serviced carefully.

Supply voltage

The supply voltage is electrically isolated from the housing.

- ☐ Use undamaged parts.
- ☐ The device does not contain any service components. Internal fuses are only triggered if there is a fault in the device. If the device is not functioning correctly, or if it is damaged, switch off the voltage supply and return the device to the plant for inspection.
- ☐ Only switch on the device when the housing is closed.
- ☐ Connect the protective conductor before you set up the other connections. When removing the connections, you remove the protective conductor last.
- ☐ Connect both protective conductors if your device is equipped with two power supply units.
- ☐ Make sure that the cross-section of the protective conductor cable is the same size as or bigger than the cross-section of the voltage supply cables.
- ☐ Only use connection cables that are permitted for the specified temperature range.

Warning: Never insert sharp objects (small screwdrivers, wires, etc.) into the field connection terminals for the supply voltage, and do not touch the terminals! There is the risk of an electric shock.

Warning:
– If the neutral conductor or the negative terminal of the supply voltage is not grounded
– If you are using a DC voltage greater than 125 VDC for the supply voltage install a suitable input fuse.
For power supply units with product code “G” or “M”, use a slow-blow fuse with a nominal rating of 2.5 A for the voltage supply input.
For power supply units with product code “C” or “L”, use a slow-blow fuse with a nominal rating of 6.3 A.
With AC power supply, use a cable cross-section of at least 0.75 mm² (North America: AWG 18) for the current conductor at the voltage input.
With DC power supply, use a cable cross-section of at least 1.0 mm² (North America: AWG 16) for the current conductor at the voltage input.

☐ Relevant for North America: For use in Class 2 circuits.
Only use copper wire/conductors of class 1, 60/75°C or 75°C.

Warning: Only connect a supply voltage that corresponds to the type plate of your device.
Power unit type “C” and “L”: 18 to 60 V DC
Power unit type “G” and “M”: 77 to 300 V DC or 90 to 265 V AC

Shielding ground

The shielding ground of the connectable twisted pairs lines is connected to the front panel as a conductor.

☐ Beware of possible short circuits when connecting a cable section with conductive shielding braiding.

Housing

Only technicians authorized by the manufacturer are permitted to open the housing.
Depending on the device variant, it is grounded

- ▶ via a separate spring-loaded terminal. This is located at the 1 or 2 power supply module(s) on the back of the device.
- ▶ via a ground connection on the front panel of the device.

☐ Make sure that the electrical installation meets local or nationally applicable safety regulations.
☐ The ventilation slots must not be covered so as to ensure free air circulation.
☐ The clearance to the ventilation slots of the housing must be at least 10 cm (3.94 in).
☐ Do not touch the housing during operation or shortly after switching off the device. Hot surfaces can cause injury.

Warning!
Never insert sharp objects (small screwdrivers, wires, etc.) into the inside of the product. There is the risk of an electric shock.

- ☐ The device must be installed in the horizontal or upright position, either in the switch cabinet or on the wall (see on page 30 “Installing the device and grounding”) The device is not intended for operation as a table unit.
- ☐ Operating the device in the maximum surrounding air temperature and stacking devices: When installing the device, make sure there is at least one free rack space (approx. 5 cm) above the device, because heat is discharged via the housing of the device.
- ☐ If you are operating the device in a 19" switch cabinet: install sliding/ mounting rails for holding the device (see on page 30 “Installing the device and grounding”).

Warning: Only install the device in rooms / plants that are only accessible to trained maintenance personnel.

- ☐ If installed in a living area or office environment, the device must be operated exclusively in switch cabinets with fire protection characteristics in accordance with EN 60950-1.

Warning: Never insert sharp objects (small screwdrivers, wires, etc.) into the field connection terminals for the supply voltage, and do not touch the terminals! There is the risk of an electric shock.

Environment

The device may only be operated at the specified surrounding air temperature (temperature of the surrounding air at a distance of up to 5 cm (1.97 in) from the device) and relative air humidity specified in the technical data.

- ☐ Install the device in a location where the climatic threshold values specified in the technical data will be observed.
- ☐ Use the device only in an environment within the contamination level specified in the technical data.

Qualification requirements for personnel

Qualified personnel as understood in this manual and the warning signs, are persons who are familiar with the setup, assembly, startup, and operation of this product and are appropriately qualified for their job. This includes, for example, those persons who have been:

- trained or directed or authorized to switch on and off, to ground and to label power circuits and devices or systems in accordance with current safety engineering standards;
- trained or directed in the care and use of appropriate safety equipment in accordance with the current standards of safety engineering;
- trained in providing first aid.

General safety instructions

Electricity is used to operate this equipment. Comply with every detail of the safety requirements specified in the operating instructions regarding the voltages to apply (see page 4).

Non-observance of these safety instructions can therefore cause material damage and/or serious injuries.

- ☐ Only appropriately qualified personnel should work on this device or in its vicinity. These personnel must be thoroughly familiar with all the warnings and maintenance procedures in accordance with this operating manual.
- ☐ The proper and safe operation of this device depends on proper handling during transport, proper storage and assembly, and conscientious operation and maintenance procedures.
- ☐ Never start operation with damaged components.
- ☐ Only use the devices in accordance with this manual. In particular, observe all warnings and safety-related information.
- ☐ Any work that may be required on the electrical installation may only be carried out by personnel trained for this purpose.

- ☐ Please note that products recommended as accessories may have characteristics that do not fully correspond to those of the corresponding product. This may limit their possible usage in the overall system.

Note: LED or LASER components in compliance with IEC 60825-1 (2001):
CLASS 1 LASER PRODUCT
CLASS 1 LED PRODUCT

Warning
Laser light
Do not look into the beam or view it directly with optical instruments (e.g. magnifying glass, microscope).
Failure to observe this warning within a distance of 100 mm can endanger your sight.
Light is emitted from the optical connections or from the ends of the optical fibers that are connected to them. Light Emitting Diode CLASS 2M, wave length 650 nm, power <2 mW, according to DIN EN 60825-1:2003-10.

National and international safety regulations

☐ Make sure that the electrical installation meets local or nationally applicable safety regulations.

CE marking

The devices comply with the regulations contained in the following European directive(s):

2004/108/EG
Directive of the European Parliament and the council for standardizing the regulations of member states with regard to electromagnetic compatibility.

2006/95/EG
Directive of the European Parliament and the council for standardizing the regulations of member states with regard to electrical equipment to be used within specific voltage ranges.

In accordance with the above-named EU directive(s), the EU conformity declaration will be at the disposal of the relevant authorities at the following address:

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The product can be used in the industrial sector.

- Interference immunity: EN 61000-6-2:2005
- Emitted interference: EN 55022:2006 + A1:2007 Class A
- Safety: EN 60950-1:2006

Warning!
This is a class A device. This device can cause interference in living areas, and in this case the operator may be required to take appropriate measures.

Warning!
The assembly guidelines provided in these instructions must be strictly adhered to in order to observe the EMC threshold values.

FCC note:

This device complies with part 15 of FCC rules. Operation is subject to the following two conditions : (1) This device may not cause harmful interference; (2) this device must accept any interference received, including interference that may cause undesired operation.
Appropriate testing has established that this device fulfills the requirements of a class A digital device in line with part 15 of the FCC regulations.
These requirements are designed to provide sufficient protection against interference when the device is being used in a business environment.
The device creates and uses high frequencies and can radiate same, and if it is not installed and used in accordance with this operating manual, it can cause radio transmission interference. The use of this device in a living area can also cause interference, and in this case the user is obliged to cover the costs of removing the interference.

Recycling note

After usage, this product must be disposed of properly as electronic waste, in accordance with the current disposal regulations of your county, state and country.

About this Manual

The “Installation” user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The following manuals are available as PDF files on the CD-ROM supplied:
- Installation user manual
- Basic Configuration user manual
- Redundancy Configuration user manual
- Web-based Interface reference guide
- Command Line Interface user manual

The HiVision Network Management Software provides you with additional options for smooth configuration and monitoring:
- Event log
- Configuration of “System Location” and “System Name”
- Configuration of the network address range and the SNMP parameters
- Saving the configuration on the device
- Simultaneous configuration of multiple devices
- Configuration of the port display color red for a connection error

With the Industrial HiVision Network Management software, you increase your network security in industrial application areas:
- ETHERNET Early Warning System
- Easy monitoring of industrial networks
- Fast display
- Interface with diagnostic and configuration programs
- Low deployment cost

Legend

The symbols used in this manual have the following meanings:

▶	Listing
☐	Work step
■	Subheading

1 Device description

The Ruggedized Switch for Substations and Transportation MACH 1000 Family provides you with a wide range of Switch variants. You set up your own Switch according to your requirements regarding the number of ports, transmission speed, media type, connector type, temperature range, voltage range and software variant.

The MACH 1000 devices are designed for the special requirements of industrial automation. They meet the relevant industry standards, provide very high operational reliability, even under extreme conditions, and also long-term reliability and flexibility. The devices work without a fan. If required, the devices are PoE-capable. For devices without PoE, the voltage supply can be redundant if required. The Switches are mounted in the switch cabinet by means of brackets, or vertically on the wall.

The HIPER-Ring redundancy concept enables you to quickly carry out a reconfiguration, and also a simple configuration with only one additional connection. Diagnosis displays and the display of the operating parameters provide a quick overview.

It can be easily managed via a Web browser, via Telnet, with a management software product (such as HiVision) or locally on the switch (V.24 interface).

The device allows you to set up switched industrial ETHERNET networks that conform to the IEEE 802.3 and 802.3u standards using copper wires or optical fibers in a line or ring structure. You can connect terminal devices and other infrastructure components via twisted pair cables, multi-mode F/O and single-mode F/O. The twisted pair ports support autocrossing, autonegotiation and autopolarity.

Depending on the software you choose, the devices provide you with a large range of functions:

- Redundancy functions
  (Rapid Spanning Tree, Redundant Ring Structure, HIPER-Ring, Redundant Coupling, Link Aggregation, for devices without PoE Redundant Power Supply)
- Protection from unauthorized access
- Synchronized system time in the network
- Network load control
- Operation diagnosis
- Diagnostics (hardware self-testing)
- Reset
- Priority
- VLAN
- Topology Discovery
- Web-based Interface
- Command Line Interface CLI

- SNMP
- 802.1x port authentication
- Real Time Clock (Professional software variant)

The addition, to the MACH 1000 Ruggedized Switch series, of the switches of the Open Rail range, the MICE range, the backbone switches of the MACH 3000 and MACH 4000 ranges, the BAT wireless transmission system, the EAGLE security system, and products for the LION control room, provides continuous communication across all levels of the company.

1.1 Description of the device variants

The devices differ with regard to the range of software functions, the number of interfaces, and the media type for connecting segments.

- The MAR1020-..., MAR1022-..., MAR1120-... and MAR1122-... device variants are MACH 1000 Ruggedized Switches without Gigabit ports and, depending on the requirements, a selectable number (up to 24) of Fast Ethernet ports (10/100 Mbit/s). You can choose the media for the Fast Ethernet ports 1 to 24 in pairs.
  The MAR1120-... and MAR1122-... devices have an additional Fast Ethernet port on the front of the device that you can use for diagnosis purposes.
  - The MAR1022-... devices support PoE in accordance with IEEE 802.3af.
    The PoE ports are the Fast Ethernet ports 1 to 4.
  - In the MAR1120-... devices, all the cable outlets are at the back, i.e. the ports are on the back of the device.
  - The MAR1122-... devices support PoE in accordance with IEEE 802.3af.
    The PoE ports are the Fast Ethernet ports 1 to 4.
    All the cable outlets are at the back, i.e. the ports are on the back of the device.
- The MAR1030-..., MAR1032-..., MAR1130-... and MAR1132-... device variants are MACH 1000 Ruggedized Switches with 2 or 4 Gigabit ports (10/100/1000 Mbit/s) and, depending on the requirements, a selectable number (up to 24) of Fast Ethernet ports (10/100 Mbit/s).
  You can choose the media for the Fast Ethernet ports 1 to 24 in pairs.
  In device variants with 2 Gigabit Ethernet ports, these ports are combo ports (2 x SFP slot: 100/1000 Mbit/s, alternatively:
  2 x twisted pair RJ45 socket: 10/100/1000 Mbit/s).
  In device variants with 4 Gigabit Ethernet ports, these can be optionally - SFP slots (2 x 2 slots),

- twisted pair RJ45 sockets (2 x 2 sockets) or
- 2 x SFP slots plus 2 x twisted pair RJ45 sockets.

The MAR1130-... and MAR1132-... devices have an additional Fast Ethernet port on the front of the device that you can use for diagnosis purposes.

- The MAR1032-... devices support PoE (Power over Ethernet) in accordance with IEEE 802.3af. The PoE ports are the Fast Ethernet ports 1 to 4.
- In the MAR1130-... devices, all the cable outlets are at the back, i.e. the ports are on the back of the device.
- The MAR1132-... devices support PoE (Power over Ethernet) in accordance with IEEE 802.3af. The PoE ports are the Fast Ethernet ports 1 to 4.
  In these devices, all the cable outlets are at the back, i.e. the ports are on the back of the device.

The devices also provide you with the following options for selecting the variant you desire:

- Temperature range:
  - Standard 0 °C to +60 °C
  - Extended -40 °C to +85 °C
  - Extended -40 °C to +85 °C, conformal coating
- Voltage range for power supply unit 1 and the optional power supply unit 2:
  - 18 VDC to 60 VDC
  - 77 VDC to 300 VDC or 90 VAC to 265 VAC

  The voltage supply connection can be a terminal or plugged connection, as desired.
  In devices with PoE, power supply unit 2 is the PoE power supply unit. You can choose the connections to power supply unit 1.
- Software variant: Professional

The devices comply with the specifications of the ISO/IEC standards
8802-3u 100BASE-TX/-1000BASE-T,
8802-3 100BASE-FX and
8802-3 1000BASE-SX/LX.

Front view of the MACH 1000 with 2 Gigabit ports

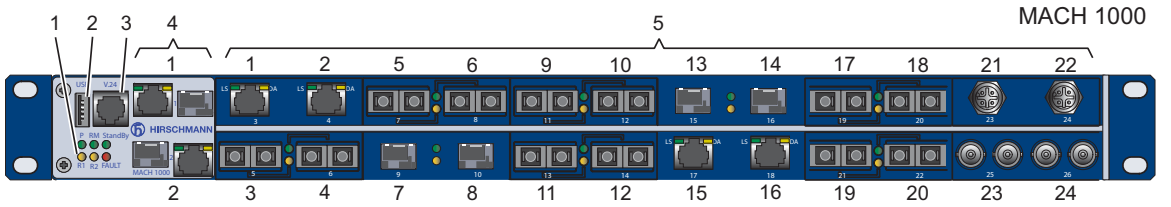


Figure 1: 1 - LED display elements
2 - USB interface
3 - V.24 connection for external management
4 - See following table, column 1
5 - See following table, column 2

Gigabit ETHERNET GE ports 1 and 2 (combo ports)	Fast ETHERNET FE ports 1 to 24, free choice of connections
100/1000 Mbit/s Fiber optic, SFP slots Alternative connections: 10/100/1000 Mbit/s Twisted pair, RJ45 connections	99: Module position empty TT: 2 * twisted pair TX, RJ45, 10/100 Mbit/s MM: 2 * Multimode FX DSC 100 Mbit/s JJ: 2 * Multimode FX MTRJ 100 Mbit/s NN: 2 * Multimode FX ST 100 Mbit/s VV: 2 * Singlemode FX DSC 100 Mbit/s UU: 2 * Singlemode FX ST 100 Mbit/s LL: 2 * Singlemode Long Haul FX DSC 100 Mbit/s GG: 2 * Singlemode Long Haul FX DSC 200 km 100 Mbit/s ZZ: 2 * SFP slot 100 Mbit/s RR: 2 * twisted pair TX, M12, 10/100 Mbit/s FF: 2 * Multimode FL ST 10 Mbit/s

Front view of the MACH 1000 with 4 Gigabit ports (SFP)

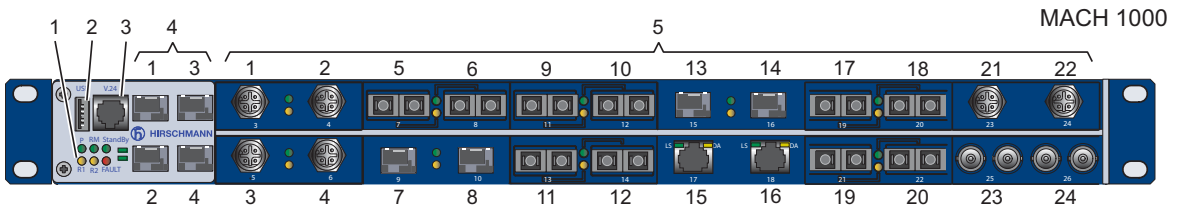


Figure 2: 1 - LED display elements
2 - USB interface
3 - V.24 connection for external management
4 - See following table, column 1
5 - See following table, column 2

Gigabit ETHERNET GE ports 1 to 4	Fast ETHERNET FE ports 1 to 24, free choice of connections
	99: Module position empty
1000 Mbit/s	TT: 2 * twisted pair TX, RJ45, 10/100 Mbit/s
Fiber optic, SFP slots	MM: 2 * Multimode FX DSC 100 Mbit/s
	JJ: 2 * Multimode FX MTRJ 100 Mbit/s
	NN: 2 * Multimode FX ST 100 Mbit/s
	VV: 2 * Singlemode FX DSC 100 Mbit/s
	UU: 2 * Singlemode FX ST 100 Mbit/s
	LL: 2 * Singlemode Long Haul FX DSC 100 Mbit/s
	GG: 2 * Singlemode Long Haul FX DSC 200 km 100 Mbit/s
	ZZ: 2 * SFP slot 100 Mbit/s
	RR: 2 * twisted pair TX, M12, 10/100 Mbit/s
	FF: 2 * Multimode FL ST 10 Mbit/s

Front view of the MACH 1000 with 4 Gigabit ports (2 x SFP and 2 x RJ45)

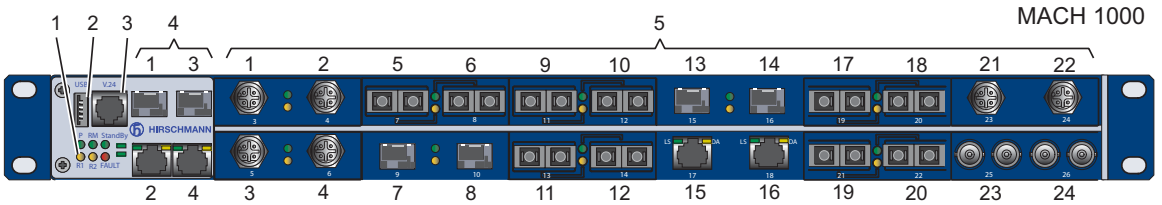


Figure 3: 1 - LED display elements
2 - USB interface
3 - V.24 connection for external management
4 - See following table, column 1
5 - See following table, column 2

Gigabit ETHERNET GE ports 1 to 4	Fast ETHERNET FE ports 1 to 24, free choice of connections
	99: Module position empty
1000 Mbit/s	TT: 2 * twisted pair TX, RJ45, 10/100 Mbit/s
Fiber optic, SFP slots	MM: 2 * Multimode FX DSC 100 Mbit/s
	JJ: 2 * Multimode FX MTRJ 100 Mbit/s
And / or:	NN: 2 * Multimode FX ST 100 Mbit/s
10/100/1000 Mbit/s	VV: 2 * Singlemode FX DSC 100 Mbit/s
Twisted pair, RJ45 connections	UU: 2 * Singlemode FX ST 100 Mbit/s
	LL: 2 * Singlemode Long Haul FX DSC 100 Mbit/s
	GG: 2 * Singlemode Long Haul FX DSC 200 km 100 Mbit/s
	ZZ: 2 * SFP slot 100 Mbit/s
	RR: 2 * twisted pair TX, M12, 10/100 Mbit/s
	FF: 2 * Multimode FL ST 10 Mbit/s

Front view of the MACH 1000 with PoE

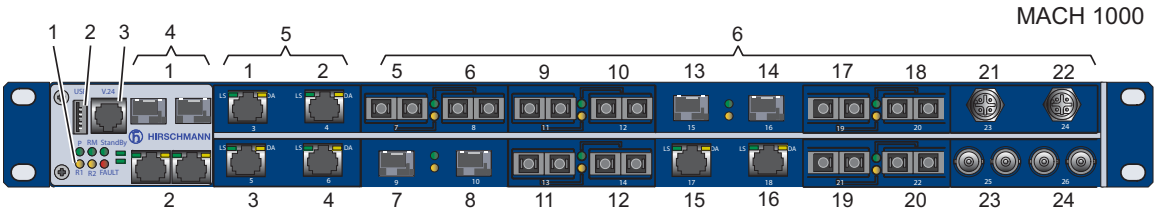


Figure 4: 1 - LED display elements
2 - USB interface
3 - V.24 connection for external management
4 - See below table 1, column 1
5 - See below table 1, column 2
6 - See below table 2

Gigabit ETHERNET Up to 4 GE ports	Fast ETHERNET FE ports 1 to 4, Power over Ethernet
1000 Mbit/s Fiber optic, SFP slots	TT: 2 * twisted pair TX, RJ45, 10/100 Mbit/s RR: 2 * twisted pair TX, M12, 10/100 Mbit/s
And / or: 10/100/1000 Mbit/s Twisted pair, RJ45 connections	Power over ETHERNET

Table 1: Gigabit ETHERNET, Fast ETHERNET FE ports 1 to 4

Fast ETHERNET FE ports 5 to 24, free choice of connections	
99:	Module position empty
TT:	2 * twisted pair TX, RJ45, 10/100 Mbit/s
MM:	2 * Multimode FX DSC 100 Mbit/s
JJ:	2 * Multimode FX MTRJ 100 Mbit/s
NN:	2 * Multimode FX ST 100 Mbit/s
VV:	2 * Singlemode FX DSC 100 Mbit/s
UU:	2 * Singlemode FX ST 100 Mbit/s
LL:	2 * Singlemode Long Haul FX DSC 100 Mbit/s
GG:	2 * Singlemode Long Haul FX DSC 200 km 100 Mbit/s
ZZ:	2 * SFP slot 100 Mbit/s
RR:	2 * twisted pair TX, M12, 10/100 Mbit/s
FF:	2 * Multimode FL ST 10 Mbit/s

Table 2: Fast ETHERNET, FE ports 5 to 24

Views of the MACH 1000, ports in the back

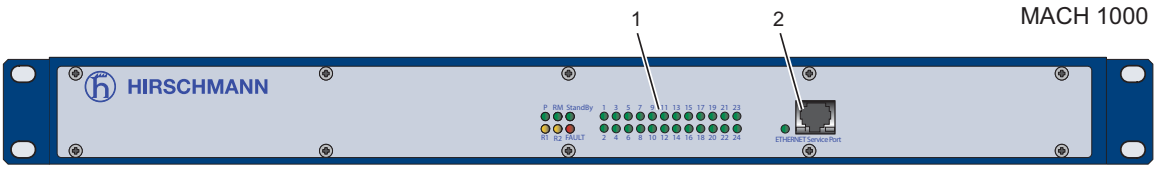


Figure 5: Front panel:
1 - LED display elements
2 - Diagnosis port

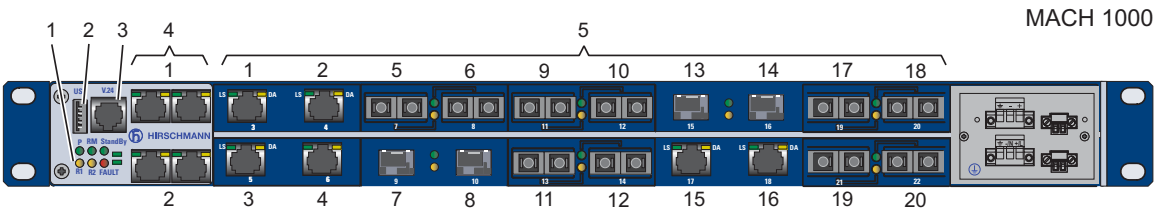


Figure 6: Rear panel:
1 - LED display elements
2 - USB interface
3 - V.24 connection for external management
4 - See following table, column 1
5 - See following table, column 2

Gigabit ETHERNET Up to 4 GE ports	Fast ETHERNET FE ports 1 to 20, free choice of connections
	99: Module position empty
1000 Mbit/s Fiber optic, SFP slots	TT: 2 * twisted pair TX, RJ45, 10/100 Mbit/s MM: 2 * Multimode FX DSC 100 Mbit/s JJ: 2 * Multimode FX MTRJ 100 Mbit/s
And / or: 10/100/1000 Mbit/s Twisted pair, RJ45 connections	NN: 2 * Multimode FX ST 100 Mbit/s VV: 2 * Singlemode FX DSC 100 Mbit/s UU: 2 * Singlemode FX ST 100 Mbit/s LL: 2 * Singlemode Long Haul FX DSC 100 Mbit/s GG: 2 * Singlemode Long Haul FX DSC 200 km 100 Mbit/s ZZ: 2 * SFP slot 100 Mbit/s RR: 2 * twisted pair TX, M12, 10/100 Mbit/s FF: 2 * Multimode FL ST 10 Mbit/s

The device variants of the MACH 1000 with ports on the rear panel have the following characteristics:

- The display LEDs are on the front of the device. There are up to 4 LEDs for displaying the status of the Gigabit Ethernet ports and up to 21 LEDs for displaying the status of the Fast Ethernet ports, as well as 6 LEDs for displaying the device status.
- The supply voltage connection and the ports are on the back of the device. The device allows you to connect a maximum of 20 Fast Ethernet ports as well as an additional Fast Ethernet port on the front of the device that you can use for diagnosis purposes.

1.2 Combination options

The product designation of your device is made from combining the desired product characteristics in accordance with the following table. The corresponding short designation is in column 3.

Item	Characteristic	Ident.	Property
1 to 7	Product	MAR1020	MACH Ruggedized Fast Ethernet Switch
		MAR1030	MACH Ruggedized Gigabit Ethernet Switch
		MAR1022	MACH Ruggedized Fast Ethernet Switch with PoE [ab]
		MAR1032	MACH Ruggedized Gigabit Ethernet Switch with PoE [ab]
		MAR1120	MACH Ruggedized Fast Ethernet Switch, ports on the back
		MAR1130	MACH Ruggedized Gigabit Ethernet Switch, ports on the back
		MAR1122	MACH Ruggedized Fast Ethernet Switch, ports on the back and with PoE [ab]
		MAR1132	MACH Ruggedized Gigabit Ethernet Switch, ports on the back and with PoE [ab]
8	- (hyphen)	-	
9 to 10	10/100/1000 Mbit/s ports 1+2 or 1 to 4	99	Not present (in MAR1020)
		CC	2 * combo port (SFP slot: 100/1000 Mbit/s, alternatively twisted pair RJ45 socket: 10/100/1000 Mbit/s)
		4O	2*2 ports Gigabit Ethernet SFP, 1000 Mbit/s
		4T	2*2 ports Gigabit Ethernet RJ45 10/100/1000 Mbit/s
		OT	2 ports Gigabit Ethernet SFP 1000 Mbit/s plus 2 ports Gigabit Ethernet RJ45 10/100/1000 Mbit/s
11 to 12	10/100 Mbit/s ports 1+2 [a)]	99	Module position empty
		TT	2 * twisted pair TX, RJ45, 10/100 Mbit/s
		MM	2 * Multimode FX DSC 100 Mbit/s
		JJ	2 * Multimode FX MTRJ 100 Mbit/s
		NN	2 * Multimode FX ST 100 Mbit/s
		VV	2 * Singlemode FX DSC 100 Mbit/s
		UU	2 * Singlemode FX ST 100 Mbit/s
		LL	2 * Singlemode Long Haul FX DSC 100 Mbit/s
		GG	2 * Singlemode Long Haul FX DSC 200 km 100 Mbit/s
		ZZ	2 * SFP slot 100 Mbit/s
		RR	2 * twisted pair TX, M12, 10/100 Mbit/s
		FF [b]	2 * Multimode FL ST 10 Mbit/s
13 to 14	10/100 Mbit/s ports 3 + 4		See 11 to 12
15 to 16	10/100 Mbit/s ports 5 + 6		See 11 to 12
17 to 18	10/100 Mbit/s ports 7 + 8		See 11 to 12
19 to 20	10/100 Mbit/s ports 9 + 10		See 11 to 12
21 to 22	10/100 Mbit/s ports 11 + 12		See 11 to 12

Table 3: Combination options for the device variants of the MACH 1000

Item	Characteristic	Ident.	Property
23 to 24	10/100 Mbit/s ports 13 + 14		See 11 to 12
25 to 26	10/100 Mbit/s ports 15 + 16		See 11 to 12
27 to 28	10/100 Mbit/s ports 17 + 18		See 11 to 12
29 to 30	10/100 Mbit/s ports 19 + 20		See 11 to 12
31 to 32	10/100 Mbit/s ports 21 + 22		See 11 to 12
33 to 34	10/100 Mbit/s ports 23 + 24		See 11 to 12
35	Temperature range	S	Standard 0 °C to +60 °C
		U	Extended -40 °C to +85 °C
		F	Extended -40 °C to +85 °C, conformal coating
36	Voltage range power supply unit 1	C	18 VDC to 60 VDC terminal connection
		G	77 VDC to 300 VDC or 90 VAC to 265 VAC terminal connection
		L	18 VDC to 60 VDC plugged connection
		M	77 VDC to 300 VDC or 90 VAC to 265 VAC plugged connection
37	Voltage range power supply unit 2 or PoE power supply unit	9	Not present
		C	18 VDC to 60 VDC terminal connection
		G	77 VDC to 300 VDC or 90 VAC to 265 VAC terminal connection
		L	18 VDC to 60 VDC plugged connection
		M	77 VDC to 300 VDC or 90 VAC to 265 VAC plugged connection
38	Certifications	H	CE, UL 508, GL, IEC 61850, IEEE 1613 Substation, EN 50121-4 Railway (along track)
		T	CE, UL 508, EN 50121-4 Railway (along track), EN 50155 Railway (train) [c]
39	Software variant	P	Professional

Table 3: Combination options for the device variants of the MACH 1000

a. In device variants with PoE (Power over Ethernet), the first four ports can be twisted pair TX RJ45 10/100 Mbit/s (short designation TT) or twisted pair TX M12 10/100 Mbit/s (short designation RR), as desired. The remaining ports can be selected freely from the table. Power supply unit 2 is a PoE power supply unit (incoming voltage range, item 37: “G” or “M”). You can choose the connections to power supply unit 1.
b. Devices with PoE or with FL ports: No „T“ certification (EN 50155 Railway (train)) available.
c. Nominal voltage on power supply type G and M: 110 VDC; on power supply type C and L: 36 VDC.

Example of MACH 1000 product designation

MAR1030-	MACH Ruggedized Switch with Gigabit ports	
CC	2 * combo port (SFP slot: 100/1000 Mbit/s, alternatively twisted pair RJ45 socket: 10/100/1000 Mbit/s)	
TT	10/100 Mbit/s ports 1 + 2:	2 * twisted pair TX, RJ45, 10/100 Mbit/s
MM	10/100 Mbit/s ports 3 + 4:	2 * Multimode FX DSC 100 Mbit/s
JJ	10/100 Mbit/s ports 5 + 6:	2 * Multimode FX MTRJ 100 Mbit/s
NN	10/100 Mbit/s ports 7 + 8:	2 * Multimode FX ST 100 Mbit/s
VV	10/100 Mbit/s ports 9 + 10:	2 * Singlemode FX DSC 100 Mbit/s
UU	10/100 Mbit/s ports 11 + 12:	2 * Singlemode FX ST 100 Mbit/s
LL	10/100 Mbit/s ports 13 + 14:	2 * Singlemode Long Haul FX DSC 100 Mbit/s
GG	10/100 Mbit/s ports 15 + 16:	2 * Singlemode Long Haul FX DSC 200 km 100 Mbit/s
ZZ	10/100 Mbit/s ports 17 + 18:	2 * SFP slot 100 Mbit/s
TT	10/100 Mbit/s ports 19 + 20:	2 * twisted pair TX, RJ45, 10/100 Mbit/s
99	10/100 Mbit/s ports 21 + 22:	Module position empty
99	10/100 Mbit/s ports 23 + 24:	Module position empty
F	Temperature range extended:	-40 °C to +85 °C, conformal coating
C	Voltage range, power supply unit 1:	18 VDC to 60 VDC
G	Voltage range, power supply unit 2:	77 VDC to 300 VDC or 90 VAC to 265 VAC
H	Certifications:	CE, UL 508, GL, IEC 61850, IEEE 1613 Substation, EN 50121-4 Railway (along track)
P	Software variant:	Professional

Table 4: Example of the product designation of a MACH 1000 with 2 Gigabit ports: MACH 1030- CC TT MM JJ NN VV UU LL GG ZZ TT 99 99 F C G H P

2 Assembly and start-up

The devices have been developed for practical application in a harsh industrial environment. The installation process is correspondingly simple.

On delivery, the device is ready for operation.
The following procedure has been proven to be successful for the assembly of the device:

- Unpacking and checking
- Installing the SFP modules (optional)
- Connecting the power unit connections for supply voltage and signal contact
- Installing the device and grounding
- Startup
- Connecting the data lines

2.1 Installing the device

2.1.1 Unpacking and checking

☐ Check that the contents of the package are complete (see page 49 “Scope of delivery”).
☐ Check the individual parts for transport damage.

2.1.2 Installing the SFP modules (optional)

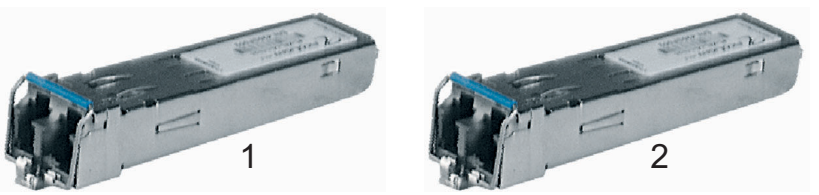


Figure 7: 1 - Fast EHTERNET fiber optic SFP module
2 - Gigabit ETHERNET fiber optic SFP module

☐ Before attaching an SFP module, first remove the protective cap over the socket.
☐ Push the SFP module with the lock closed into the socket until it latches audibly in place.

Note: Only use Hirschmann SFP modules (see page 50 “Accessories”).

2.1.3 Connecting the power unit connections for supply voltage and signal contact

☐ Connect the power supply and signal lines.

Note: Note the safety instructions (see on page 4 “Supply voltage”) and only connect a supply voltage that corresponds to the type plate of your device. Make sure that the contact load capability of the signal contact is not exceeded (see on page 44 “Technical data”).

Connecting the supply voltage

Connecting the supply voltage:

- For device types with power units of the type “C” or “G” (voltage supply terminal connection) via a 3-pin spring-loaded terminal, the signal contact is connected via a 2-pin spring-loaded terminal to the power units (power unit 1 and/or power unit 2, depending on the device variant) on the back of the MACH1000 device.
- For device types with power units of the type “L” or “M” (voltage supply plugged connection) via a 3-pin terminal block with screw locking, the signal contact is connected via a 2-pin terminal block (1 or 2 blocks, depending on the device variant) on the back of the MACH1000 device.

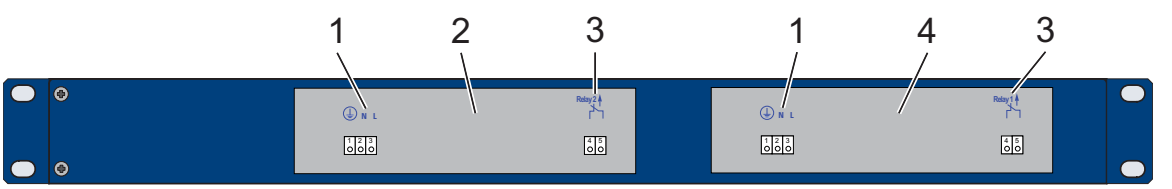


Figure 8: MACH 1000, back of device, terminal voltage connection
1 - Supply voltage
2 - Power unit 2 (optional)
3 - Signal contact
4 - Power unit 1

Figure 9: MACH 1000 device variants (back of device), plugged voltage connection
1 - Power unit 1
2 - Power unit 2 (optional)
3 - 2 Terminal blocks for signal contact
4 - 2 Terminal blocks for supply voltage
5 - 1 Terminal block for supply voltage
6 - 1 Terminal block for signal contact

For device variants without PoE: The supply voltage in MACH 1000 device types can be connected redundantly with two power units. Both inputs are uncoupled.
The supply voltage is electrically isolated from the housing.

MACH 1000 devices without PoE

MACH 1000 device variants without PoE (Power over Ethernet) are, depending on the device type, equipped with one or two power units of the following type:

- Type “C” (18 VDC to 60 VDC, see product code items 36 and 37 in table 3 and/or
- Type “G” (77 VDC to 300 VDC or 90 VAC to 265 VAC, see product code items 36 and 37 in table 3

or

- Type “L” (18 VDC to 60 VDC, see product code items 36 and 37 in table 3 and/or
- Type “M” (77 VDC to 300 VDC or 90 VAC to 265 VAC, see product code items 36 and 37 in table 3.

Note: For device variants without PoE: For device variants with two power units, if there is non-redundant voltage supply, the device reports the failure of one supply voltage. You can prevent this message by applying the supply voltage via both inputs, or by changing the configuration in the Management.

MACH 1000 devices with PoE

The MACH 1000 device variants MAR1022-..., MAR1032-..., MAR1132-... and MAR 1132-... support Power over Ethernet (PoE) in accordance with IEEE 802.3af. They allow the connection and remote supply of, for example, IP telephones (Voice over IP), webcams, sensors, printer servers and WLAN access points via 10BASE-T/100BASE-TX. With PoE, these terminal devices are powered by the twisted-pair cable.

The MACH 1000 devices with PoE have 2*2 twisted pair ports TX 10/100 Mbit/s, depending on the device variant, as RJ45 or M12 sockets for connecting network segments or PoE terminal devices (PD, Powered Device) for all IEEE802.3af classes up to a maximum power output of 15.4 W.
The current is supplied on wire pairs transmitting the signal; the individual ports are not electrically insulated from each other.

The following conditions are met in accordance with IEEE 802.3af:

- Endpoint PSE
- Alternative A

MACH 1000 device variants without PoE (Power over Ethernet) are equipped with two power units.

- Power unit 2 is a PoE power unit, see product code item 37 in table 3.
- You can choose the connections to power unit 1, see product code item 36 in table 3.

MACH 1000 devices with terminal connection voltage supply

MACH 1000 devices with product code “C” and “G” have a terminal connection for the supply voltage, see product code items 36 and 37 in table 3.

Warning: Never insert sharp objects (small screwdrivers, wires, etc.) into the field connection terminals for the supply voltage, and do not touch the terminals! There is the risk of an electric shock.

Note: Observe the permitted voltage ranges for devices with type „T“ certifications (EN 50155 Railway (train), see product code item 38 in table 3).

- ▶Power supply type G and M: nominal voltage 110 VDC
- ▶Power supply type C and L: nominal voltage 36 VDC

☐ To insert the cable, you open the terminal lock by positioning the screwdriver as illustrated below and pressing on the lever.

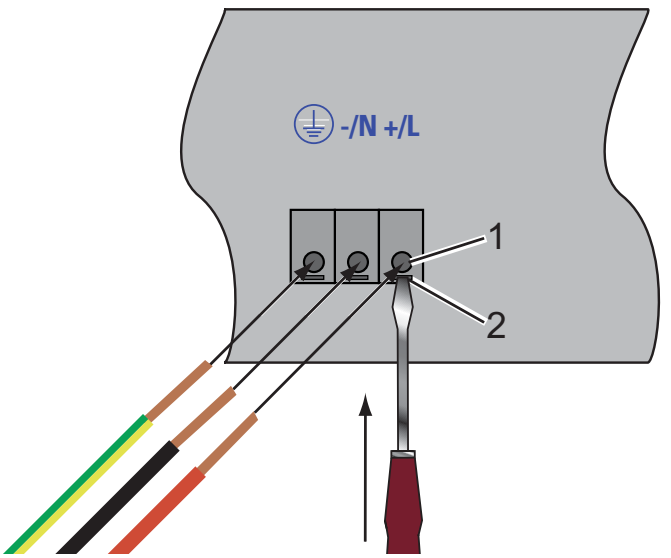


Figure 10: Connecting the supply voltage via the 3-pin spring-loaded terminal
1 - Field connection terminal for supply voltage
2 - Terminal lock

☐ First connect the protective conductor to the protective conductor terminal.

☐ Connect the supply voltage via the 3-pin spring-loaded terminal. Pay attention to the +/L and -/N connections.

☐ If the neutral conductor or the minus terminal of the supply voltage is not grounded, install a suitable fuse in the input line.

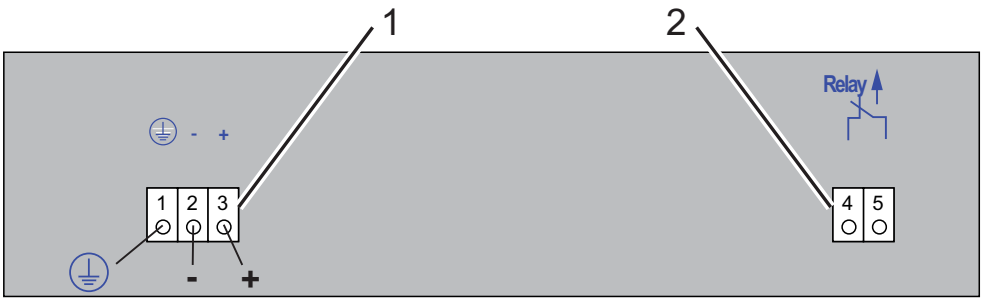


Figure 11: Back of MACH 1000 device with power unit “C”,
DC voltage (18...60 VDC)
Connecting
1 - Supply voltage
2 - Signal contact

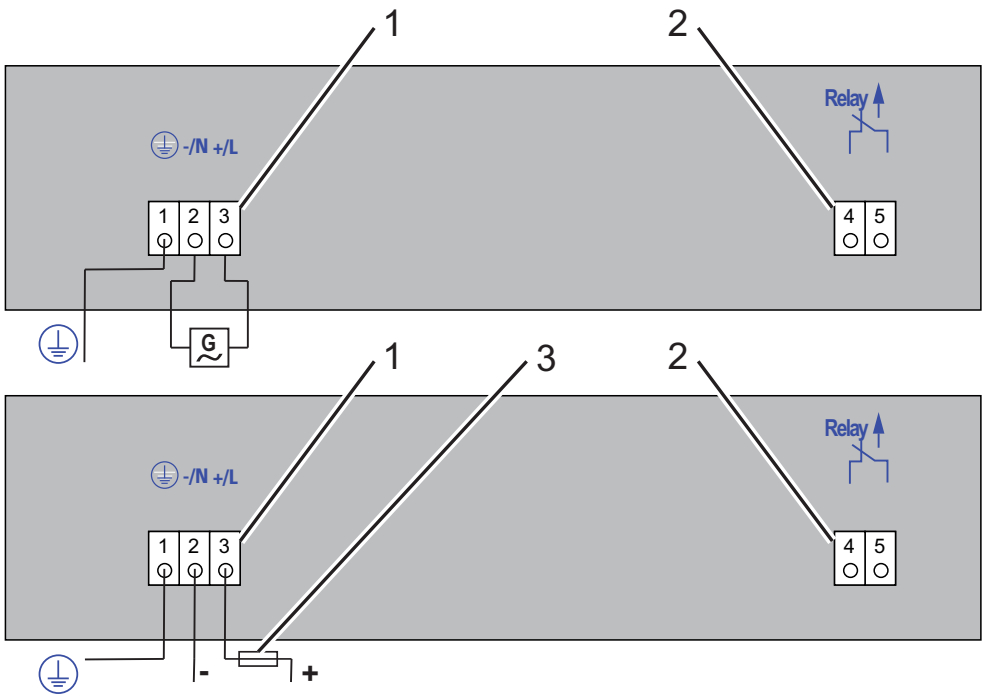


Figure 12: Back of MACH 1000 device with power unit “G”,
AC voltage 90-265 VAC (top image) or
DC voltage 77-300 VDC (bottom image)
Connecting
1 - Supply voltage
2 - Signal contact
3 - External fuse for supply voltages > 125 VDC

Connection	Type “C”	Type “G” VDC	Type “G” VAC
⏚ , pin 1	Protective conductor	Protective conductor	Protective conductor
-/N, pin 2	Minus terminal of the supply voltage	Minus terminal of the supply voltage	Neutral conductor
+/L, pin 3	Plus terminal of the supply voltage	Plus terminal of the supply voltage	“Phase” supply voltage

Table 5: Pin assignment of spring-loaded terminal for voltage supply

For type “G” power units, you can choose between connecting DC or AC voltage.

☐ For supply voltages > 125 VDC:
Install a suitable external fuse in the supply voltage input line of the plus terminal (see fig. 12).

MACH 1000 devices with plugged connection voltage supply

MACH 1000 devices with product code “L” and “M” have a plugged connection for the supply voltage, see product code items 36 and 37 (see table 3).

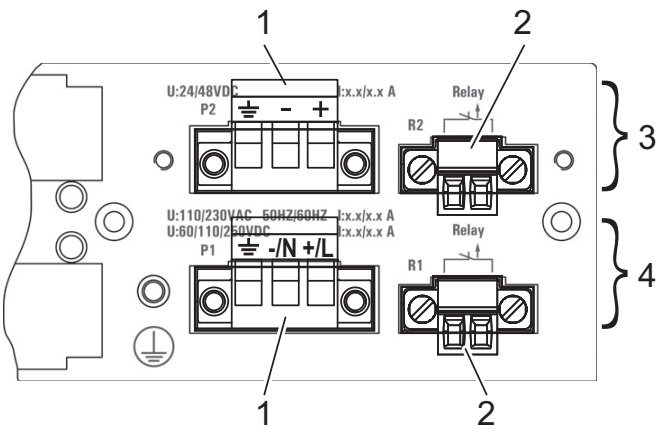


Figure 13: Location of the supply voltage plugged connection

1 - Supply voltage
2 - Signal contact
3 - Voltage range L: 18-60 VDC
4 - Voltage range M: 77-300 VDC or 90-265 VAC

Warning: Never insert sharp objects (small screwdrivers, wires, etc.) into the terminal block for the supply voltage, and do not touch the terminals! There is the risk of an electric shock.

Note: Note the safety instructions (see on page 4 “Supply voltage”) and only connect a supply voltage that corresponds to the type plate of your device. Make sure that the contact load capability of the signal contact is not exceeded (see on page 44 “Technical data”).

Note: Observe the permitted voltage ranges for devices with type „T“ certifications (EN 50155 Railway (train), see product code item 38 in table 3).
- ▶Power supply type G and M: nominal voltage 110 VDC
- ▶Power supply type C and L: nominal voltage 36 VDC

Note: Relevant for North America:
The tightening torque of the terminal block screws is 3 lb in. (0.34 Nm).

- ☐ Pull the terminal block(s) off the switch and connect the voltage supply lines as follows:
- ☐ First connect the protective conductor to the protective conductor terminal.
- ☐ Connect the supply voltage via the 3-pin terminal block. Pay attention to the +/L and -/N connections.
- ☐ If the neutral conductor or the minus terminal of the supply voltage is not grounded, install a suitable fuse in the input line.

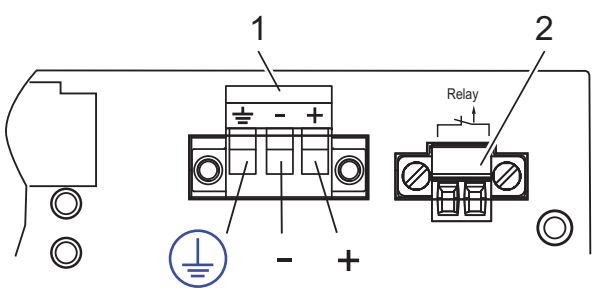


Figure 14: Back of MACH 1000 device with power unit “L”, DC voltage (18...60 VDC) Connecting
1 - Supply voltage
2 - Signal contact

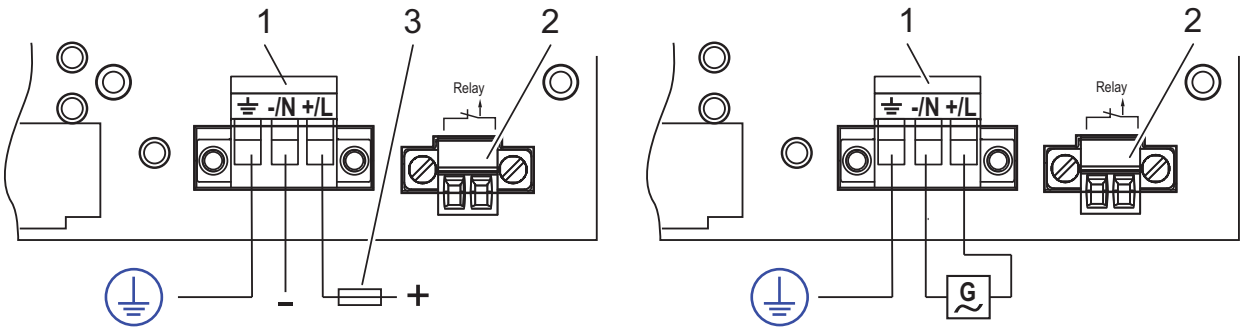


Figure 15: Back of MACH 1000 device with power unit “M”,
AC voltage 90-265 VAC (right image) or
DC voltage 77-300 VDC (left image)
Connecting
1 - Supply voltage
2 - Signal contact
3 - External fuse for supply voltages > 125 VDC

Connection	Type “L”	Type “M” VDC	Type “M” VAC
⏚ , pin 1	Protective conductor	Protective conductor	Protective conductor
-/N, pin 2	Minus terminal of the supply voltage	Minus terminal of the supply voltage	Neutral conductor
+/L, pin 3	Plus terminal of the supply voltage	Plus terminal of the supply voltage	“Phase” supply voltage

Table 6: Pin assignment of spring-loaded terminal for voltage supply

For type “M” power units, you can choose between connecting DC or AC voltage.

☐ For supply voltages > 125 VDC:
Install a suitable external fuse in the supply voltage input line of the plus terminal (see fig. 12).

Note: The terminal blocks for devices with power unit type “M” (type “L”) are coded to prevent them from being accidently connected to devices with power unit type “L” (type “M”).

Connecting the PoE supply voltage (optional)

The devices connected are supplied with PoE voltage (48 V DC safety low voltage) via an internal power supply unit.
The twisted-pair cables at Fast Ethernet ports 1 to 4 of the device are supplied with PoE voltage via the wire pairs transmitting the signal (phantom voltage) for both RJ45 and M12.

“FAULT” signal contact

Depending on the MACH 1000 device variant (equipped with one or two power units), you have either one or two signal contacts.

- The signal contact monitors proper functioning of the device, thus enabling remote diagnostics. You can specify the type of function monitoring in the Management.
  Pin assignment: for MACH 1000 devices
  – with terminal voltage supply (see fig. 11), (see fig. 12)
  – with plugged voltage supply (see fig. 14), (see fig. 15)
- You can also use the Management to switch the signal contact manually and thus control external devices.

A break in contact is used to report the following conditions via the potential-free signal contact (relay contact, closed circuit):

- The failure of at least one supply voltage.
- A continuous malfunction in the device.
- The loss of connection at at least one port. The report of the link status can be masked by the Management for each port. In the delivery state, link status monitoring is deactivated.
- The loss of ring redundancy reserve.
- A detected error during the self-test.
- Incorrect configuration of the HIPER-Ring or ring coupling.
- Permitted temperature range exceeded/not reached.

The following condition is also reported in RM mode:

- Ring redundancy reserve is available. On delivery, there is no ring redundancy monitoring.

Note: You can use the signal contact functions when the voltage supply is connected. If there is redundant voltage supply, but this is turned off, there is a contact interruption at the corresponding signal contact.

2.1.4 Installing the device and grounding

Note: The shielding ground of the connectable industrial twisted pair lines is connected to the front panel as a conductor.

Mounting in a 19“ rack

The devices are designed to be mounted in a 19" rack.

☐ Make sure there is sufficient ventilation. If necessary, provide a fan for the 19" rack. This will prevent the basic devices from overheating.

☐ Measure the depth of the 19" rack so as to allow the main cable, and any power supply cables, to be fitted from the back, and the data cables to be fitted from the front.

If you are operating the device in a 19" switch cabinet, you must install sliding/mounting rails (not included in the delivery) to hold the weight of the device.

Warning!
If the device is installed in a 19" switch cabinet without sliding/ mounting rails, increased vibration can cause damage to the device and/or its modules.

For more information on sliding/mounting rails and how to install them, please contact your switch cabinet manufacturer.

☐ Install the sliding/mounting rails in the 19" switch cabinet as instructed by the manufacturer, and make sure the device is resting on both rails.

On delivery, two brackets are attached to the sides of the device (see figure below).

☐ Fasten the device by screwing the brackets to the switch cabinet.

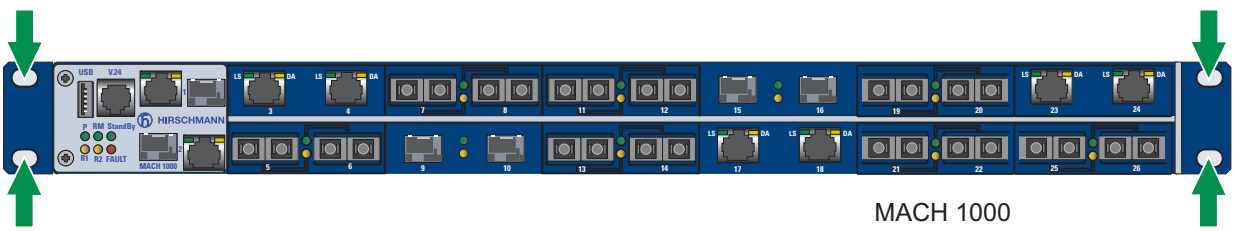


Figure 16: Mounting in the switch cabinet

Warning!
When installing the device, make sure the ventilation slots remain unobstructed, as otherwise the device can overheat and be damaged.

Note: Fasten the device with two additional brackets at the back of the switch cabinet when operating it in environments with strong vibrations (see on page 50 “Accessories”, not included in the delivery).

Vertical mounting on the wall

☐ Use the pre-mounted brackets included in the delivery as shown in the following figure (see fig. 17).

☐ Attach two additional brackets to the device (see on page 50 “Accessories”, not included in the delivery) as shown in the following figure (see fig. 17).

☐ Fasten the device by screwing the brackets to the wall.

Warning!
When installing the device, make sure the ventilation slots remain unobstructed, as otherwise the device can overheat and be damaged.

Note: The shielding ground of the connectable industrial twisted pair lines is connected to the front panel as a conductor.

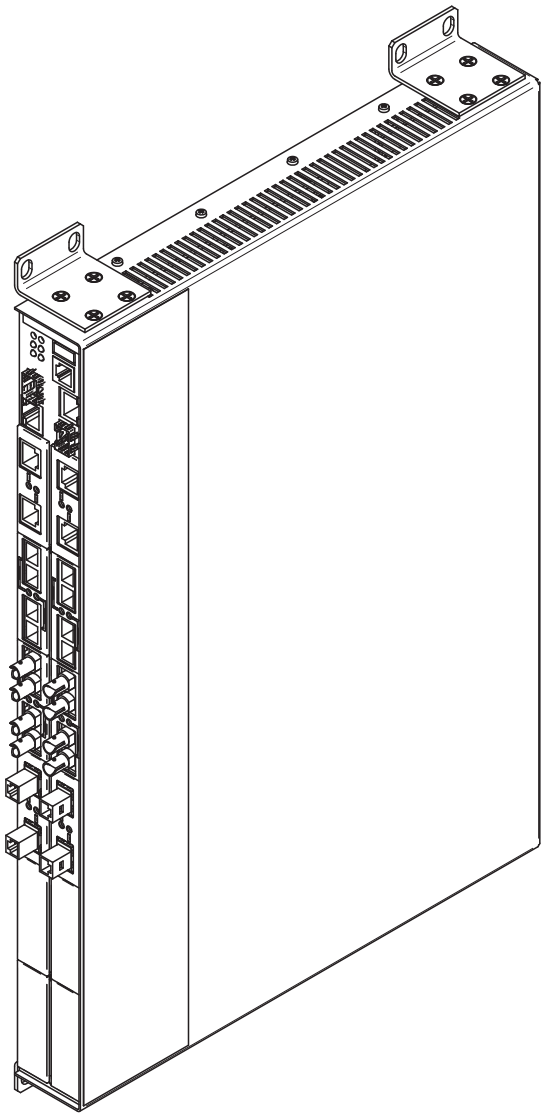


Figure 17: Vertical mounting on the wall

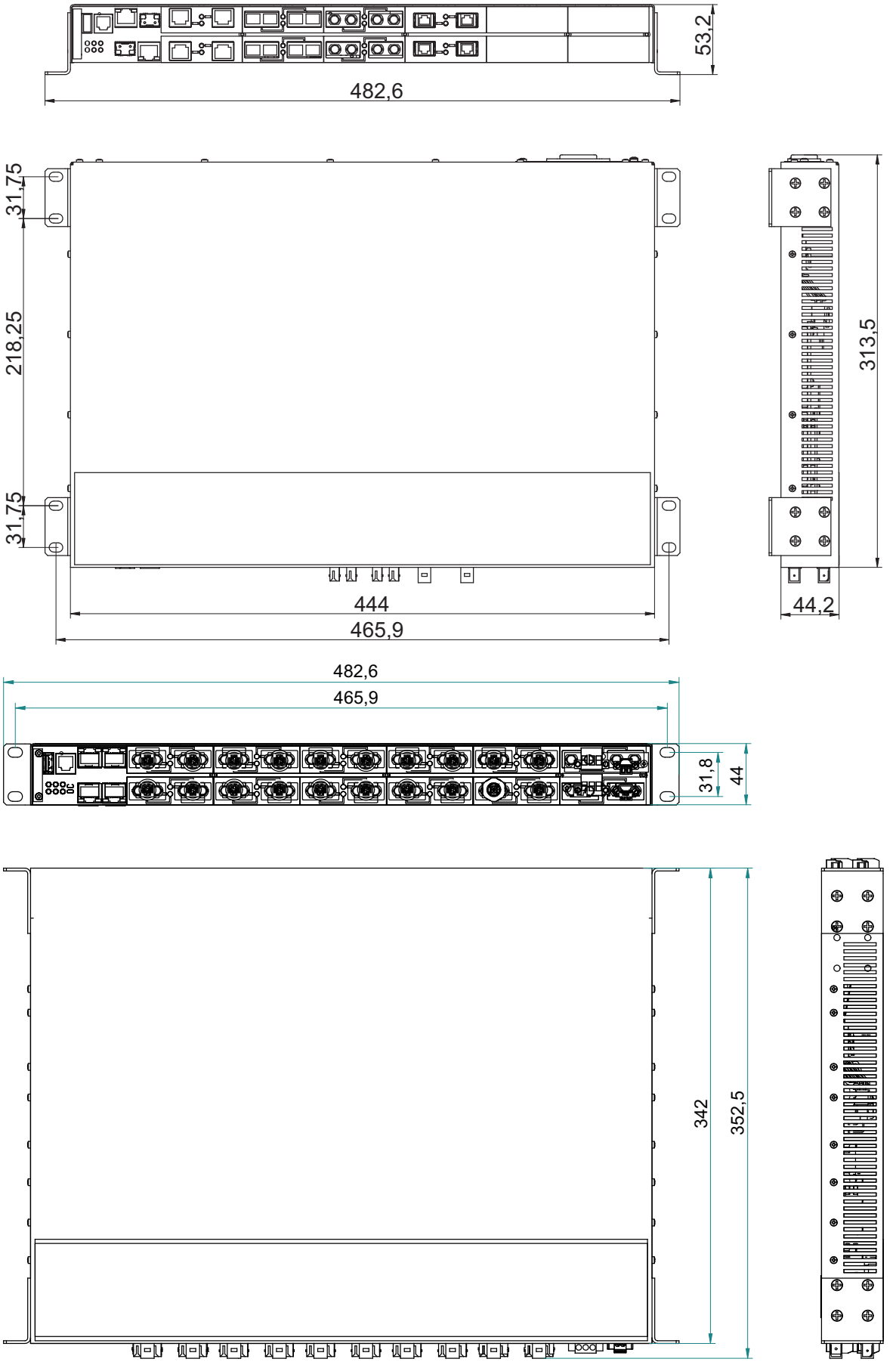


Figure 18: MACH 1000, dimensions of device variants

Grounding the device

The device is grounded as follows:

- for MACH 1000 devices with terminal connection voltage supply via a separate spring-loaded terminal.
  This is located at the 1 or 2 power supply modules on the back of the device, at pin 1 (see fig. 11 and fig. 12).
- for MACH 1000 devices with plugged connection voltage supply: via a ground connection on the front panel of the device (see fig. 13).

☐ Connect the protective conductor before you set up the other connections. When removing the connections, you remove the protective conductor last.

☐ Connect both protective conductors if your device is equipped with two power supply units.

2.1.5 Startup procedure

When you connect the supply voltage, you start up the device.

2.1.6 Connecting the data lines

You can connect terminal devices and other segments at the ports of the device via twisted pair cables or F/O cables.

☐ Install the data lines according to your requirements.

Note: To optimize the data flow, connect the main data traffic to ports 1 and 4.

10/100 Mbit/s twisted pair connection

10/100 Mbit/s ports (RJ45 socket) enable the connection of terminal devices or independent network segments according to the IEEE 802.3 100BASE-TX and 10BASE-T standard.

These ports support:

- Autonegotiation
- Autopolarity
- Autocrossing (if autonegotiation is activated)
- 100 Mbit/s half-duplex mode, 100 Mbit/s full duplex mode
- 10 Mbit/s half-duplex mode, 10 Mbit/s full duplex mode

State on delivery: autonegotiation activated.

The socket housing is electrically connected to the front panel.

Pin assignment of the RJ45 socket:

☐ One line pair: pin 3 and pin 6

☐ One line pair: pin 1 and pin 2

☐ Remaining pins: not used.

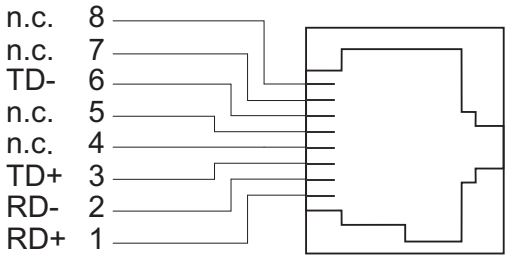


Figure 19: Pin assignment of a TP/TX interface in MDI-X mode, RJ45 socket

Note: In substation applications, the RJ45 ports are used to connect to additional communication devices such as routers or telecommunication multiplexers that are installed in close proximity to the device (i.e. less than 3 meters away). It is not recommended to use these ports for connection to field devices across longer distances which could cause a significant increase in the ground potential (Ground Potential Rise GPR, i.e. more than 2500 V).

10/100/1000 Mbit/s twisted pair connection

1000 Mbit/s twisted pair ports (RJ45 sockets) facilitate the connection of terminal devices or independent network segments according to the IEEE 802.3-2000 (ISO/IEC 8802-3:2000) 1000BASE-TX standard.

These ports support:

- Autonegotiation
- Autopolarity
- Autocrossing (if autonegotiation is activated)
- 1000 Mbit/s full duplex
- 100 Mbit/s half duplex, 100 Mbit/s full duplex,
- 10 Mbit/s half duplex, 10 Mbit/s full duplex.

Default settings: autonegotiation.

The socket housing is electrically connected to the front panel.

The pin assignment corresponds to MDI-X.

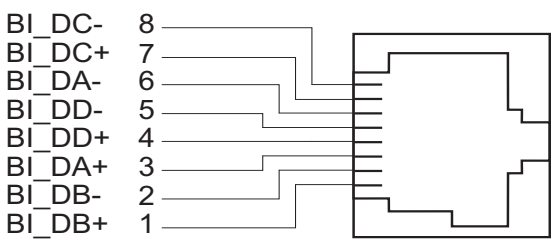


Figure 20: Pin assignment of the 1000 Mbit/s twisted pair interface

Note: In general, you should adhere to the following recommendations for data cable connections using copper in environments with high electrical interference levels:

- Keep the length of the data cables as short as possible - ideally max. 3m long. You should not use any copper data cables for the data transmission between buildings.
- Power supply and data cables should not run parallel over longer distances, and ideally they should be installed in separate cable channels. If the inductive coupling has to be reduced, the power supply and data cables should cross at a 90° angle.
- You may also choose to use shielded cables. Ground the cable shielding at one point in order to avoid causing a ground loop.

10/100 Mbit/s twisted pair connection PoE

10/100 Mbit/s ports (RJ45 or M12 sockets) enable the connection of terminal devices or independent network segments according to the IEEE 802.3 100BASE-TX / 10BASE-T and IEEE 802.3af (Power over ETHERNET on data lines) standards. These ports support:

- Autonegotiation
- Autopolarity
- Autocrossing (if autonegotiation is activated)
- 100 Mbit/s half-duplex mode, 100 Mbit/s full duplex mode
- 10 Mbit/s half-duplex mode, 10 Mbit/s full duplex mode
- Power over ETHERNET (PoE)

State on delivery: autonegotiation activated.
The socket housing is electrically connected to the front panel.
The PoE voltage is input via the wire pairs transmitting the signal (phantom voltage).

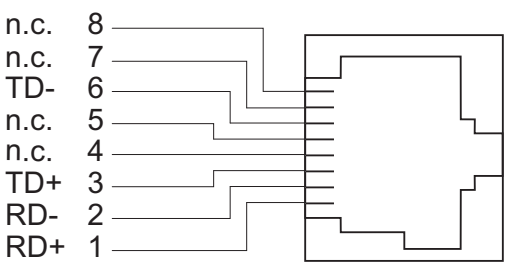


Figure 21: Pin assignment of a TP/TX interface in MDI-X mode, RJ45 socket

Figure	Pin	Function		PoE (PSE)
	1	TX+	Transmit Data +	+
	2	RX+	Receive Data +	-
	3	TX-	Transmit Data -	+
	4	RX-	Receive Data -	-
	Chassis	Shield		

Table 7: Pin assignment of the TP/TX interface for PoE (M12 socket)

- ☐ Use a shielded CAT5 cable.
- ☐ Use a shielded 4-pin M12 plug.

☐ Connect the cable shield to the connector housing.

The patch cables for operating the device are shown in the following figure:

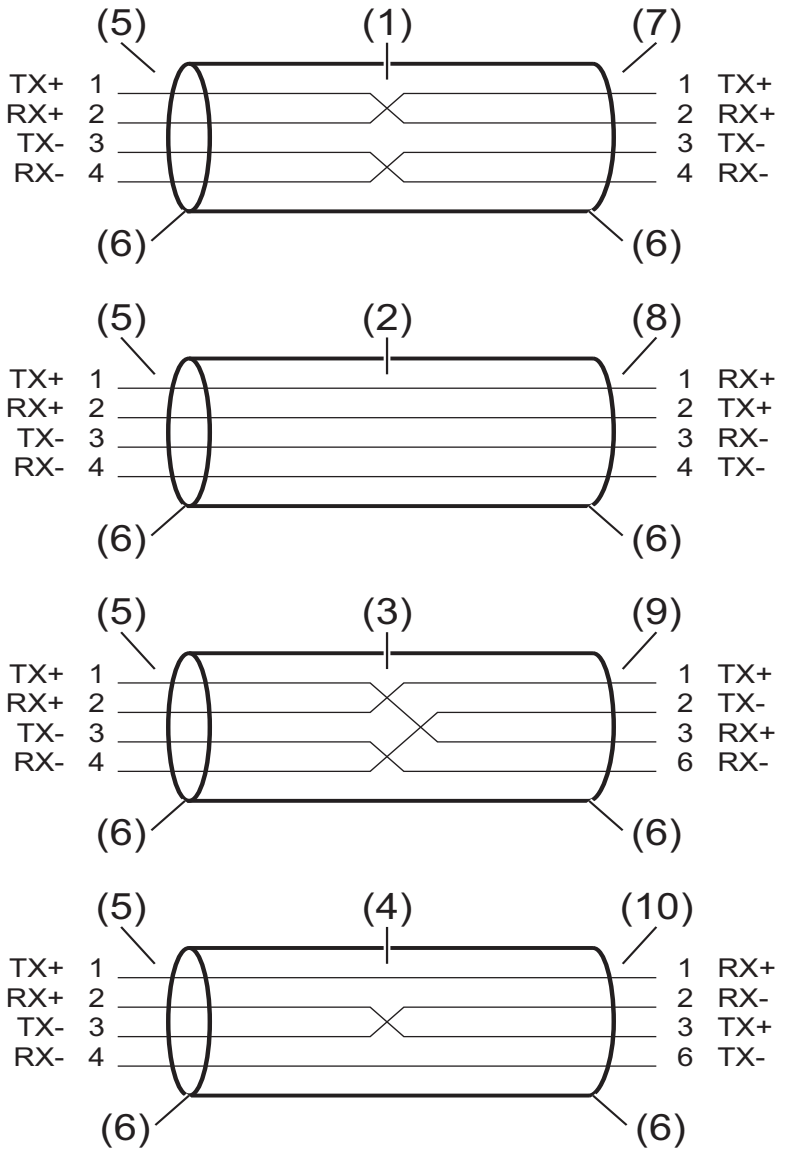


Figure 22: Patch cables for operating the device

(1) - Connection cables M12-4 on M12-4, crossed
(2) - Connection cables M12-4 on M12-4, 1 to 1
(3) - Connection cables M12-4 on RJ45, crossed
(4) - Connection cables M12-4 on RJ45, 1 to 1
(5) - M12 (MDI)
(6) - Shield
(7) - M12 (MDI)
(8) - M12 (MDI-X via autocrossing port)
(9) - RJ45, MDI (terminal device)
(10) - RJ45, MDI-X (Switch)

10 Mbit/s F/O connection

10 MBit/s F/O ports (ST connectors) enable the connection of terminal devices or independent network segments in compliance with the IEEE 802.3 10BASE-FL standard.

- Full or half duplex mode

State on delivery: full duplex FDX

100 Mbit/s F/O connection

100 MBit/s F/O ports (ST, DSC, MTRJ or SFP slot) enable the connection of terminal devices or independent network segments in compliance with the IEEE 802.3 100BASE-FX standard. These ports support:

- Full or half duplex mode

State on delivery: full duplex FDX

Note: Make sure that the LH ports are only connected with LH ports, SM ports are only connected with SM ports, and MM ports only with MM ports.

1 Gbit/s F/O connection

1 GBit/s F/O ports (SFP slot) enable the connection of terminal devices or independent network segments in compliance with the IEEE 802.3-2000 (ISO/IEC 8802-3:2000) 1000BASE-SX or 1000BASE-LX standards. These ports support:

- Autonegotiation

State on delivery: autonegotiation activated.

Note: Make sure that the LH ports are only connected with LH ports, SX ports are only connected with SX ports, and LX ports only with LX ports.

Note: With the MACH 1030 with two Gbit/s F/O ports, these ports are combo ports (SFP/RJ45). You can use either the SFP slot or the RJ45 socket to connect data lines. If both are used, the assigned SFP slot switches off the related RJ45 port.

2.2 Display elements

After the operating voltage is set up, the software starts and initializes itself. Afterwards, the device performs a self-test. During this process, various LEDs light up. The process takes around 60 seconds.

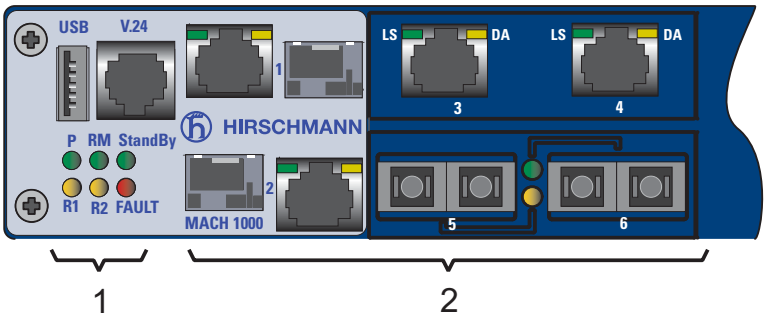


Figure 23: Display elements of MACH 1000, device variants with ports on the front

1 - Device status display elements

2 - Port status display elements

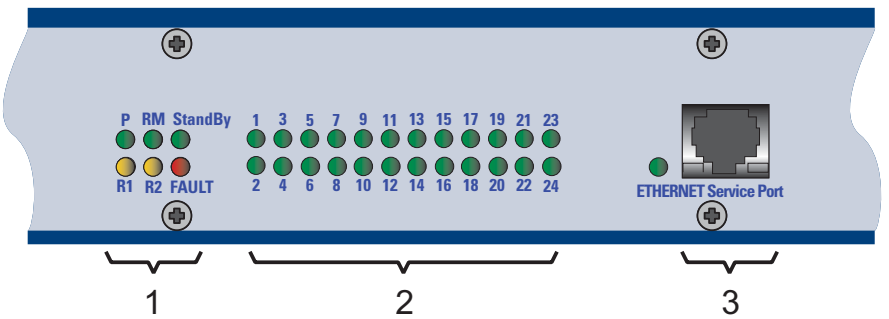


Figure 24: Display elements of MACH 1000, device variants with ports on the back

1 - Device status display elements

2 - Port status display elements for up to 4 Gigabit Ethernet ports and up to 20 Fast Ethernet ports

3 - Diagnosis port with display element

Device state

These LEDs provide information about conditions which affect the operation of the whole device.

P - Power (green/yellow LED)	
Glowing green	Device variants with 2 power supply units: Both supply voltages are on Device variants with 1 power supply unit: Supply voltage is on
Glowing yellow	Device variants with 2 power supply units: There is only one supply voltage (P1 or P2) on
Not glowing	Supply voltage is too low
RM - Ring Manager (green/yellow LED)	
Glowing green	RM function active, redundant port disabled
Glowing yellow	RM function active, redundant port enabled
Not glowing	RM function not active
Flashing green	Incorrect configuration of the HIPER-Ring (e.g. the ring is not connected to the ring port).
Sb StandBy - stand-by mode (green LED)	
Glowing green	Stand-by mode enabled.
Not glowing	No stand-by mode.

RM and Stand-by - display saving processes of the AutoConfiguration Adapter (ACA)	
Flashing alternately	Error during saving process.
LEDs flash synchronously, two times a second	Loading configuration from the ACA.
LEDs flash synchronously, once a second	Saving the configuration in the ACA.

Applies to software releases previous to 06.0.00:

LED	Display	Color	Activity	Meaning
FAULT	Signal contact 1	Red	Lights up	The signal contact is open, it is reporting an error.
			None	Signal contact is closed, it is not reporting an error.

Applies to software release 06.0.00 and higher:

LED	Display	Color	Activity	Meaning
FAULT	Signal contact 1	Red	Lights up	The signal contact is open, it is reporting an error.
			None	Signal contact is closed, it is not reporting an error.
	Duplicate IP detection	Red	Flashing 4 times a period	Reports an IP conflict.

Applies to software releases previous to 06.0.00:

LED	Display	Color	Activity	Meaning
R1	Signal contact 1	Yellow	Lights up	The signal contact is closed in manual operation.
			None	The signal contact is open in manual operation.
R2	Signal contact 2	Yellow	Lights up	The signal contact is closed in manual operation.
			None	The signal contact is open in manual operation.

Applies to software release 06.0.00 and higher:

LED	Display	Color	Activity	Meaning
R1	Signal contact 1	Yellow	Lights up	The signal contact is open.
			None	The signal contact is closed.
R2	Signal contact 2	Yellow	Lights up	The signal contact is open.
			None	The signal contact is closed.

If the manual adjustment is active on the signal contact, then the error display is independent of the setting of the signal contact.

Port state

The green and yellow LEDs at the individual port display port-related information. During the boot phase, these LEDs are used to display the status of the boot procedure.

LS - data, link status (one green/yellow LED or one green and one yellow LED)	
Not glowing	No valid connection.
Glowing green	Valid connection.
Flashing green (1 time a period)	Port is switched to stand-by.
Flashing green (3 times a period)	Port is switched off.
Flashing yellow	Data reception.

2.3 Basic set-up

The IP parameters must be entered when the device is installed for the first time. The device provides 6 options for configuring IP addresses:

- Entry via V.24 connection
- Entry using the HiDiscovery protocol
- Configuration via BOOTP
- Configuration via DHCP
- Configuration via DHCP Option 82
- Auto Configuration Adapter

Further information on the basic settings of the device can be found in the "Basic Configuration" user manual on the CD ROM.

Default settings

- IP address: The device looks for the IP address using DHCP
- Password for management:
  Login: user; password: public (read only)
  Login: admin; password: private (read and write)
- Parameters that can be set via the management are set to pre-defined values in accordance with the MIB
- V.24 data rate: 9,600 Baud
- Ring redundancy: disabled
- Ethernet ports: link status is not evaluated (signal contact)
- Optical 100 Mbit/s ports: 100 Mbit/s, full duplex
  All other ports: autonegotiation
- Ring manager disabled
- Stand-by coupling: disabled
  Port 4 = control port, port 3 = coupling port for red. Ring coupling

USB interface

The USB socket has an interface for the local connection of an AutoConfiguration Adapter (part number ACA 21-USB see on page 50 “Accessories”). It is used for saving/loading the configuration and for loading the software.

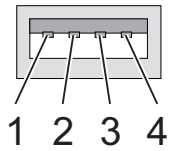
Figure	Pin	Function
	1	VCC (VBus)
	2	- Data
	3	+ Data
	4	Ground (GND)

Table 8: Pin assignment of the USB interface

V.24 interface (external management)

The V.24 interface is an RJ11 socket.

The V.24 interface is a serial interface which allows you to connect the following devices locally:

- An external management station (VT100 terminal or PC with appropriate terminal emulation). This enables you to set up a connection to the Command Line Interface (CLI) and to the system monitor.
- An AutoConfiguration Adapter ACA 11

VT 100 terminal settings	
Speed	9,600 Baud
Data	8 bit
Stopbit	1 bit
Handshake	off
Parity	none

The socket housing is electrically connected to the front panel of the device.

The V.24 interface is not electrically isolated from the supply voltage.

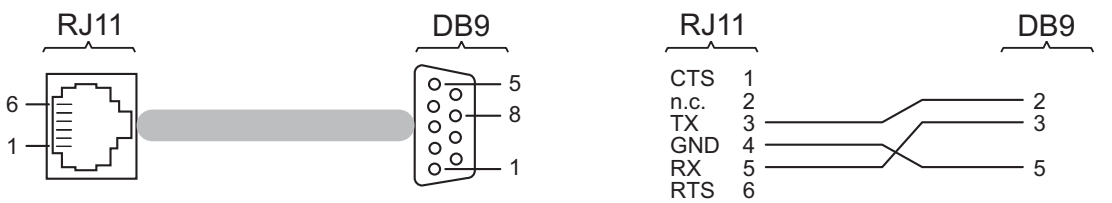


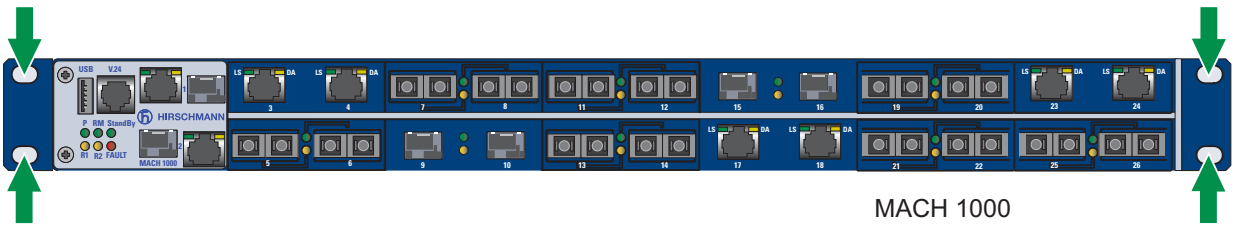
Figure 25: Pin assignment of the V.24 interface and the DB9 connector

Note: You will find the order number for the terminal cable, which is ordered separately, in the Technical Data chapter (see on page 44 “Technical data”).

You will find a description of the V.24 interface in the “Basic Configuration User Manual” on the CD-ROM.

2.4 Disassembling the device

☐ To detach the device from the switch cabinet or the wall, remove the screws from the brackets on the device.



3 Technical data

General technical data

Dimensions W × D × H	MAR10...	448 × 310 × 44 mm (without brackets)
	MAR11... (deeper chassis structure)	448 × 345 × 44 mm (without brackets)
Weight (incl. redundant power unit or PoE power unit)	MAR1020-... fully equipped	max. 4.6 kg
	MAR1030-... fully equipped	max. 4.7 kg
	MAR1120-... fully equipped (incl. redundant power unit)	max. 5.4 kg
	MAR1130-... fully equipped (incl. redundant power unit)	max. 5.5 kg
	MAR1122-... fully equipped	max. 5.5 kg
	MAR1132-... fully equipped	max. 5.6 kg
	MAR1022-... fully equipped	max. 4.7 kg
	MAR1032-... fully equipped	max. 4.8 kg
Weight	MAR1020-... basic device	approx. 3.9 kg
	MAR1030-... basic device	approx. 4.0 kg
	MAR1120-... basic device	approx. 4.7 kg
	MAR1130-... basic device	approx. 4.8 kg
	MAR1122-... basic device	approx. 5.1 kg
	MAR1132-... basic device	approx. 5.2 kg
	MAR1022-... basic device	approx. 4.3 kg
	MAR1032-... basic device	approx. 4.4 kg
	Optional PoE power unit Optional second power unit Per 6 ports (3 modules) Per M12 module	approx. 0.39 kg additional approx. 0.3 kg additional approx. 0.1 kg additional approx. 0.09 kg
Power supply Power unit type “G” and “M”	Nominal voltage AC Voltage range AC Nominal voltage DC Voltage range DC Connection type “G” Connection type “M” Power failure bypass	100 - 240 V, 50 - 60 Hz 90 - 265 V, 47 - 63 Hz 110 - 250 V (devices with type „T“ certification: 110 V) 77 - 300 V Spring-loaded terminal for copper wire with cross-section AWG 20-12 (0.5 to 3.0 mm2) and stripping length 12 mm 3-pin terminal block > 20 ms at 230 V AC
Power unit type “C” and “L”	Fuse Nominal voltage DC Voltage range DC Connection type “C” Connection type “L” Power failure bypass Fuse	Built into the power unit 24 - 48 V (devices with type „T“ certification: 36 V) 18 - 60 V Spring-loaded terminal for copper wire with cross-section AWG 20-12 (0.5 to 3.0 mm2) and stripping length 12 mm 3-pin terminal block > 10 ms at 20.4 V DC Built into the power unit

Power supply for device variants with PoE	Input voltage DC	77 V … 300 V (110 V … 250 V -30% … +25%)
	Input voltage AC	90 V … 265 V (110 V … 230 V -20% … +15%)
	Output voltage	48 V DC ± 5%
"FAULT" signal contact	Nominal value for AC Nominal value for DC	2 A at 230 V AC (500 VA) 2 A at 30 V DC 0.2 A at 125 V DC 0.1 A at 250 V DC
	Connection type	Spring-loaded terminal for copper wire with cross-section AWG 20-12 (0.5 to 3.0 mm2) and stripping length 12 mm
Environment	Storage temperature (ambient air) Humidity Air pressure	Standard: -40 °C to +70 °C Extended: -40 °C to +85 °C 5% to 95% (non-condensing) Up to 2000 m (795 hPa), higher altitudes on request
Operating temperature	Default (surrounding air) Extended (surrounding air)	0 °C to +60 °C -40 °C to +85 °C [abcd]
Contamination level		2
Protection classes	Laser protection Protection class	Class 1 according to EN 60825-1 (2001) IP 30

a. For devices with an extended temperature range equipped with more than 14 F/O ports, the maximum operating temperature is reduced by 1K for each additional F/O port. Example: MACH 1000 device with extended temperature range and 20 F/O ports: Operating temperature = -40 °C to +79 °C.
b. MACH 1000 device equipped with "GG" Fast Ethernet modules (Singlemode Long Haul FX DSC 200 km): 0 °C to +60 °C
c. -40 °C to + 70 °C for devices with PoE, devices with FL ports and devices with 4 Gigabit Ethernet ports
d. Relevant for North America: max. surrounding air temperature: +70°C

EMC and immunity

EMC interference immunity IEC/EN 61850-3:2002 EMI TYPE tests, test in comp. with	Description	Test level
IEC/EN 61000-4-2	Electrostatic discharge	
	Contact discharge	+/- 8 kV
	Air discharge	+/- 15 kV
IEC/EN 61000-4-3	Electromagnetic field	
	80 - 2,700 MHz	20 V/m
IEC/EN 61000-4-4	Fast transients (burst)	
	DC power line	+/- 4 kV (2.5 kHz)
	AC power line	+/- 4 kV (2.5 kHz)
	Data line	+/- 4 kV (2.5 kHz)

EMC interference immunity IEC/EN 61850-3:2002 EMI TYPE tests, test in comp. with	Description	Test level
IEC/EN 61000-4-5	Voltage surges	
	DC power line	+/- 2 kV line / earth; +/- 1 kV line / line
	AC power line	+/- 4 kV line / earth; +/- 2 kV line / line
	Data line	+/- 4 kV line / earth
IEC/EN 61000-4-6	Line-conducted interference voltages 150 kHz - 80 MHz	10 V
IEC/EN 61000-4-12	Damped vibration	
	DC power line	+/- 2.5kV line / earth; +/- 1kV line / line
	AC power line	+/- 2.5kV line / earth; +/- 1kV line / line
	Data line	+/- 2.5kV line / earth; +/- 1kV line / line
IEC 60255-5	Dielectric strength	
	DC power line; power unit type C, L	500 VAC
	AC power line; power unit type G, M	2000 VAC
	DC power line; power unit type G, M	2000 VAC
	Signal contact type C, L and G, M	2000 VAC

EMC interference immunity IEEE 1613:2009 EMI TYPE tests, test in comp. with	Description	Test level
IEEE C37.90.3	Electrostatic discharge	
	Contact discharge	+/- 8 kV
	Air discharge	+/- 15 kV
IEEE C37.90.2	Electromagnetic field	
	80 - 1,000MHz	35 V/m (peak)
IEEE C37.90.1	Fast transients (burst)	
	DC power line	+/- 4 kV (2.5 kHz)
	AC power line	+/- 4 kV (2.5 kHz)
	Data line	+/- 4 kV (2.5 kHz)
IEEE C37.90.1	Damped vibration	
	DC power line	+/- 2.5kV line / earth; +/- 1kV line / line
	AC power line	+/- 2.5kV line / earth; +/- 1kV line / line
	Data line	+/- 2.5kV line / earth; +/- 1kV line / line
IEEE C37.90	H.V. impulse	
	DC power line	+/- 5 kV line / earth
	AC power line	+/- 5 kV line / earth
IEEE C37.90	Dielectric strength	
	DC power line; power unit type C, L	500 VAC
	AC power line; power unit type G, M	2000 VAC
	DC power line; power unit type G, M	2000 VAC
	Signal contact type C, L and G, M	2000 VAC

EMC emitted interference	
EN 55022	Class A
FCC 47 CFR Part 15	Class A
German Lloyd	Classification + Construction Guidelines VI-7-3 Part 1 Ed.2001

Environment type tests, test in comp. with	Description	Test level
IEC 60068-2-1	Cold	-40 °C, 16 hours
IEC 60068-2-2	Dry heat	+85 °C, 16 hours
IEC 60068-2-30	Relative humidity	95 % (non condensing) 55 °C, 4 cycles
IEC 60068-2-6	Vibration, test Fc	2- 9 Hz with 3 mm amplitude 1 g at 9 - 150 Hz 1.5 g at 200 - 500 Hz
IEC 60068-2-27	Shock, test Ea	15 g at 11 ms

Network range

TP port	
Length of a twisted pair segment	max. 100 m / 328 ft (cat5e cable with 1000BASE-T)

Table 9: TP port 10BASE-T / 100BASE-TX / 1000BASE-T

Product code		Wave-length	Fiber	System attenuation	Expansion	Fiber data
-FF	MM	820 nm	50/125 µm	0-9.5 dB	0-2.1 km	3.0 dB/km; 400 MHz*km
-FF	MM	820 nm	62.5/125 µm	0-12.5 dB	0-3.0 km	3.2 dB/km; 200 MHz*km

Table 10: F/O port 10BASE-FL

Product code		Wave-length	Fiber	System attenuation	Expansion	Fiber data
-JJ, -MM, -NN	MM	1300 nm	50/125 µm	0-8 dB	0-5 km	1.0 dB/km, 800 MHz*km
-JJ, -MM, -NN	MM	1300 nm	62.5/125 µm	0-11 dB	0-4 km	1.0 dB/km, 500 MHz*km
-VV, -UU	SM	1300 nm	9/125 µm	0-16 dB	0-30 km	0.4 dB/km; 3.5 ps/(nm*km)
-LL	LH	1550 nm	9/125 µm	7-29 dB	24-86 km	0.3 dB/km; 19 ps/(nm*km)
-GG	LH+	1550 nm	9/125 µm	14-47 dB	67-176 km	0.25 dB/km; 19 ps/(nm*km)

Table 11: F/O port 100BASE-FX

Product code M-FAST-SFP-...		Wave length	Fiber	System attenuation	Expansion	Fiber data
-MM/LC...	MM	1310 nm	50/125 µm	0-8 dB	0-5 km	1.0 dB/km, 800 MHz*km
-MM/LC...	MM	1310 nm	62.5/125 µm	0-11 dB	0-4 km	1.0 dB/km, 500 MHz*km
-SM/LC...	SM	1310 nm	9/125 µm	0-13 dB	0-25 km	0.4 dB/km; 3.5 ps/(nm*km)
-SM+/LC...	SM	1310 nm	9/125 µm	10-29 dB	25-65 km	0.4 dB/km; 3.5 ps/(nm*km)
-LH/LC	SM	1550 nm	9/125 µm	10-29 dB	40-104 km	0.25 dB/km; 19 ps/(nm*km)

Table 12: Fiber port 100BASE-FX (SFP fiber optic Fast ETHERNET Transceiver)

Product code M-SFP-...		Wave length	Fiber	System attenuation	Expansion	Fiber data
-SX/LC...	MM	850 nm	50/125 µm	0-7.5 dB	0-550 m	3.0 dB/km, 400 MHz*km
-SX/LC...	MM	850 nm	62.5/125 µm	0-7.5 dB	0-275 m	3.2 dB/km, 200 MHz*km
-MX/LC...	MM	1310 nm	50/125 µm	0-8 dB	2 km [a]	1.0 dB/km, 500 MHz*km
-MX/LC	MM	1310 nm	62.5/125 µm	0-8 dB	1 km	1.0 dB/km, 500 MHz*km
-LX/LC...	MM	1310 nm[b]	50/125 µm	0-11 dB	0-550 m	1.0 dB/km, 800 MHz*km
-LX/LC...	MM	1310 nm [b]	62.5/125 µm	0-11 dB	0-550 m	1.0 dB/km, 500 MHz*km
-LX/LC...	SM	1310 nm	9/125 µm	0-11 dB	0-20 km	0.4 dB/km; 3.5 ps/(nm*km)
-LX+/LC	SM	1310 nm	9/125 µm	5-20 dB	14-42 km	0.4 dB/km; 3.5 ps/(nm*km)
-LH/LC...	LH	1550 nm	9/125 µm	6-22 dB	24-72 km	0.25 dB/km; 19 ps/(nm*km)
-LH+/LC	LH	1550 nm	9/125 µm	15-30 dB	71-108 km	0.25 dB/km; 19 ps/(nm*km)
-LH+/LC	LH	1550 nm	9/125 µm	15-30 dB	71-128 km	0.21 dB/km (typical); 19 ps/(nm*km)

Table 13: Fiber port 1000BASE-FX (SFP fiber optic Gigabit ETHERNET Transceiver)

a. Distances up to 3 km reachable, 1000 MHz*km (1300 nm)
b. With F/O adapter compliant with IEEE 802.3-2002 clause 38 (single-mode fiber offset-launch mode conditioning patch cord)

Product code M-SFP-BIDI...		Wave length TX	Wave length RX	Fiber	System attenuation	Expansion	Fiber data
Type A LX/LC EEC	SM	1310 nm	1550 nm	9/125 µm	0-11 dB	0-20 km	0.4 dB/km, 3.5 ps/(nm*km)
Type B LX/LC EEC	SM	1550 nm	1310 nm	9/125 µm	0-11 dB	0-20 km	0.25 dB/km, 19 ps/(nm*km)
Type A LH/LC EEC	LH	1490 nm	1590 nm	9/125 µm	5-24 dB	23-80 km	0.25 dB/km, 19 ps/(nm*km)
Type B LH/LC EEC	LH	1590 nm	1490 nm	9/125 µm	5-24 dB	23-80 km	0.25 dB/km, 19 ps/(nm*km)

Table 14: F/O port (bidirectional Gigabit ETHERNET SFP Transceiver)

MM = Multimode, SM = Singlemode, LH = Singlemode Longhaul

Power consumption/power output

Name	Power consumption	Power output
Basic devices		
MAR1020-... basic device (without Fast Ethernet modules)	7.5 W	25.6 Btu (IT)/h
MAR1030-... basic device (incl. 2 Gigabit Ethernet module combo ports, without Fast Ethernet modules)	10.5 W	35.9 Btu (IT)/h
MAR 1x3y-4O... basic device (x = 0 or 1, y = 0 or 2)	11.5 W	39.2 Btu (IT)/h
MAR 1x3y-4T... basic device (x = 0 or 1, y = 0 or 2)	14.5 W	49.5 Btu (IT)/h
MAR 1x3y-OT... basic device (x = 0 or 1, y = 0 or 2)	13.0 W	44.4 Btu (IT)/h
Fast Ethernet modules		
additionally for each Fast Ethernet FX module	2.0 W	6.9 Btu (IT)/h
additionally for each Fast Ethernet TX module	0.4 W	1.4 Btu (IT)/h
additionally for each PoE module	38.0 W	130.0 Btu (IT)/h
Examples		
MAR1020-99TTTTTTTTTTTTTTTTTTTTTTTTUG9HPHHXX.X	12.3 W	42.0 Btu (IT)/h
MAR1020-99TTTTTTTTTTTTMMMMMMMMMMMMMUG9HPHHXX.X	21.9 W	74.8 Btu (IT)/h
MAR1020-99MMMMMMMMMMMMMMMMMMMMMMMMUG9HPHHXX.X	31.5 W	107.5 Btu (IT)/h
MAR1030-CCTTTTTTTTTTTTTTTTTTTTTTTTUG9HPHHXX.X	15.3 W	52.2 Btu (IT)/h
MAR1030-CCTTTTTTTTTTTTMMMMMMMMMMMMMUG9HPHHXX.X	24.9 W	85.0 Btu (IT)/h
MAR1030-CCMMMMMMMMMMMMMMMMMMMMMMMMUG9HPHHXX.X	34.5 W	117.8 Btu (IT)/h
MAR1030-4TMMMMMMMMMMMMMMMMMMMMMMMMUG9HPHHXX.X	38.5 W	131.4 Btu (IT)/h
MAR1032-4TTTRRMMMMMMMMMM MMMMMMMMMUGGHPHHXX.X, non-PD (powered device)	35.3 W	120.5 Btu (IT)/h
MAR1132-4OTTRRMMMMMMMMMM MMMMM9999UGGHPHHXX.X, non-PD (powered device)	28.3 W	96.6 Btu (IT)/h
MAR1032-4TTTRRMMMMMMMMMM MMMMMMMMUGGHPHHXX.X, 4 x Class0-PD (powered device)	111.3 W	380.5 Btu (IT)/h
MAR1132-4OTTRRMMMMMMMMMM MMM9999UGGHPHHXX.X, 4 x Class0-PD (powered device)	104.3 W	356.6 Btu (IT)/h

Scope of delivery

Device	Scope of delivery
MAR...	MAR... device Installation user manual CD-ROM

Order numbers/product description

Combination options and device names (see table 3).

Accessories

Note: Please note that products recommended as accessories may have characteristics that do not fully correspond to those of the corresponding product. This may limit their possible usage in the overall system.

Name	Operating temperature (chassis)	Order number
AutoConfiguration Adapter ACA 21-USB		943 271-001
Terminal cable		943 301-001
3-pin terminal block high voltage interlock (50 pieces)		943 845-008
3-pin terminal block low voltage interlock (50 pieces)		943 845-011
Bracket for fastening the housing		943 943-001
Dust protection cap for RJ 45 sockets (50 pcs.)		943 936-001
Dust protection cap for SFP slots (25 pcs.)		943 942-001
HiVision Network Management software		943 471-100
OPC Server software HiOPC		943 055-001
Gigabit ETHERNET SFP Transceiver		
M-SFP-SX/LC	0 °C to +60 °C	943 014-001
M - SFP - SX / LC EEC	-40 °C to +70 °C	943 896-001
M - SFP - MX / LC	0 °C to +60 °C	942 035-001
M-SFP-LX/LC	0 °C to +60 °C	943 015-001
M - SFP - LX / LC EEC	-40 °C to +70 °C	943 897-001
M - SFP - LX+ / LC	0 °C to +60 °C	942 023-001
M - SFP - LX+/ LC EEC	-40 °C to +70 °C	942 024-001
M-SFP-LH/LC	0 °C to +60 °C	943 042-001
M - SFP - LH / LC EEC	-40 °C to +70 °C	943 898-001
M-SFP-LH+/LC	0 °C to +60 °C	943 049-001
Fast ETHERNET SFP Transceiver		
M-FAST SFP-MM/LC	0 °C to +60 °C	943 865-001
M-FAST SFP-MM/LC EEC	-40 °C to +70 °C	943 945-001
M-FAST SFP-SM/LC	0 °C to +60 °C	943 866-001
M-FAST SFP-SM/LC EEC	-40 °C to +70 °C	943 946-001
M-FAST SFP-SM+/LC	0 °C to +60 °C	943 867-001
M-FAST SFP-SM+/LC EEC	-40 °C to +70 °C	943 947-001
M-FAST SFP-LH/LC	0 °C to +60 °C	943 868-001
M-FAST SFP-LH/LC EEC	-40 °C to +70 °C	943 948-001
Bidirectional Gigabit ETHERNET SFP Transceiver		
M-SFP-BIDI Type A LX/LC EEC	-40 °C to +70 °C	943 974-001
M-SFP-BIDI Type B LX/LC EEC	-40 °C to +70 °C	943 974-002
M-SFP-BIDI Type A LH/LC EEC	-40 °C to +70 °C	943 975-001

Name	Operating temperature (chassis)	Order number
M-SFP-BIDI Type B LH/LC EEC	-40 °C to +70 °C	943 975-002
M-SFP-BIDI Bundle LX/LC EEC (Type A + B)	-40 °C to +70 °C	943 974-101
M-SFP-BIDI Bundle LH/LC EEC (Type A + B)	-40 °C to +70 °C	943 975-101

Underlying norms and standards

Name	
EN 61000-6-2:2005	Generic norm – immunity in industrial environments
EN 55022:2006 + A1:2007	IT equipment – radio interference characteristics
IEC/EN 60950-1:2006	Safety for the installation of IT equipment
EN 61131-2:2007	Programmable logic controllers
EN 50121-4:2006	Railway applications - EMC - emitted interference and interference immunity for signal and telecommunication systems
EN 50155:2007	Railway applications - electronic systems in railway vehicles
FCC 47 CFR Part 15:2009	Code of Federal Regulations
Germanischer Lloyd	Ship Applications - Classification and Construction Guidelines VI-7-3 Part 1 Ed.2003
cUL 508:1998	Safety for Industrial Control Equipment
EN 61850-3	Communications networks and systems in stations
IEEE 1613	Standard Environment and Testing Requirements for Communication Networking Devices in Electric Power Substations

Table 15: List of norms and standards

IEEE 802.1 D	Switching, GARP, GMRP, Spanning Tree
IEEE 802.1 D-1998	Media access control (MAC) bridges (includes IEEE 802.1p Priority and Dynamic Multicast Filtering, GARP, GMRP)
IEEE 802.1 Q	Tagging
IEEE 802.1 Q-1998	Virtual Bridged Local Area Networks (VLAN Tagging, GVRP)
IEEE 802.1 w.2001	Rapid Reconfiguration
IEEE 802.3-2002	Ethernet

Table 16: List of IEEE standards

The device has a certification based on a specific standard only if the certification indicator appears on the housing.
However, with the exception of Germanischer Lloyd, ship certifications as well as RINA certifications are only included in the product information under www.beldensolutions.com.

A Further Support

Technical Questions and Training Courses

In the event of technical queries, please contact your local Hirschmann distributor or Hirschmann office.
You can find the addresses of our distributors on the Internet: www.beldensolutions.com.

Our support line is also at your disposal:

- Tel. +49 1805 14-1538
- Fax +49 7127 14-1551

Answers to Frequently Asked Questions can be found on the Hirschmann internet site (www.beldensolutions.com) at the end of the product sites in the FAQ category.
The current training courses to technology and products can be found under http://www.hicomcenter.com.

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